RISK ADJUSTMENT FOR SUBSTANCE ABUSE PATIENTS:

An Accurate Casemix Model Should Include Information Obtained Directly from Patients at Baseline

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A Report from the Substance Abuse Module,
Quality Enhancement Research Initiative (QUERI)

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Executive Summary

Background. Risk adjustment is an important tool for substance abuse treatment evaluations. Differences in patients' characteristics across treatment programs or facilities should be taken into account before comparing programs' or facilities' performance on patient outcomes. Although there has been considerable research on casemix adjustment in the substance abuse area, no standard casemix model is available for use in VA substance abuse treatment evaluation studies.

Objective. To develop a standard casemix model for use in the evaluation of treatment effectiveness for projects conducted under the auspices of the QUERI Substance Abuse Module (QSAM). We also examine the adequacy of casemix adjustment using only data available from the Department of Veterans Affairs (VA) health care utilization databases, and focus on the added value of information obtained directly from patients about their baseline substance use, symptoms, and social functioning.

Method. We utilize information from two evaluations of VA patients with substance use disorders to develop casemix models, and examine their results for substance use, symptom, and social functioning outcomes. We also compare risk adjusted outcomes across facilities using only indices readily available from the VA utilization databases with the results of risk adjustment using these indices and information obtained from patients at baseline about their status.

Results. The following patient characteristics are included in the final casemix model: age, marital status, gender, prior treatment, Axis I and Axis II psychiatric diagnoses, and patients' self-report information about their baseline status. Baseline information was the strongest predictor and significantly added to the model for all outcomes. Findings were similar in the two samples. Patients' relative outcomes across facilities differed when baseline status was added to the risk adjustment model.

Conclusions. These findings suggest that the proposed casemix model can be useful for VA substance abuse evaluation studies. They also illustrate the importance of including information about patients' baseline status in casemix adjustment.

Recommendations. We recommend that the model presented in this report be used in QSAM evaluations. This standard casemix model can serve as a basis for the development of more detailed models for specific projects where needed. We also recommend that a casemix index include patients' reports of their baseline status, as well as information from the VA utilization databases.

Introduction

This report describes the development of a standard casemix model to risk adjust patients' outcomes in the evaluation of treatment effectiveness for projects that are conducted under the auspices of the Quality Enhancement Research Initiative (QUERI) Substance Abuse Module (QSAM). One of the QSAM's goals is to examine the effectiveness of probable best practices across multiple VA substance abuse treatment programs and facilities. To evaluate effectiveness, a method is needed to adjust for differences in patient characteristics across programs or facilities. Accordingly, we set out a basic model that adjusts for the initial prognosis of substance use disorder patients and controls for pre-existing differences between groups of patients in studies of treatment outcome.

Ideally, data on patient characteristics for casemix adjustment should be easy to obtain. In that vein, we also examine the adequacy of risk adjustment using only readily available data from the Department of Veterans Affairs (VA) health care utilization databases, and focus on the added value of more costly information obtained directly from patients at baseline. To meet this goal, we compare the results of risk adjustment based on data drawn from the VA health care utilization databases with the results of risk adjustment using these data and information obtained from patients at baseline about their substance use, symptoms, and social functioning.

Risk adjustment is an important tool in health services research. In brief, casemix or risk adjustment is a method to statistically control for the effects of patient characteristics that may influence outcome status. Controlling for these prognostic characteristics removes their influence on the outcome and makes it possible to evaluate the relationship of treatment to outcomes more directly. Adjusting for patient casemix has often been referred to as "leveling the playing field" (MDRC, 1997) and is particularly important when there are systematic differences between patients across the units of analyses, such as differences in the severity of substance use disorders among patients treated in different programs or facilities.

Conceptually, casemix adjustment is similar to statistically controlling for pre-existing group differences in naturalistic or nonexperimental designs, or in experimental designs in which randomization has not produced equivalent groups. In some treatment evaluations, researchers may want to adjust for patient characteristics that vary across treatment conditions and predict outcome. In contrast, the development of casemix adjustment models typically focuses only on patient characteristics that have consistent prognostic significance, rather than on those that vary between programs or regions. When programs/facilities vary on the prognostic patient characteristics included in a casemix model, however, casemix adjustment will affect program/facility performance standings.

Several studies have demonstrated the importance of using casemix adjustment in comparisons among substance abuse programs. For example, Phibbs, Swindle, and Recine (1997) calculated 6-month readmission rates to VA hospital-based substance abuse treatment facilities with and without casemix adjustment, and then examined facility-level readmission rates. Facility rankings on readmission rates differed substantially depending upon whether casemix adjustment was employed. For example, one VA had an unadjusted readmission rate of 19%, but a casemix-adjusted readmission rate of 30%. In a related project, Swindle et al. (1995) showed patient casemix to be the strongest predictor of readmission rates and early dropout rates; programs with a less severe patient casemix had lower readmission and dropout rates.

These results demonstrate how casemix adjustment can affect comparisons of performance across programs or facilities. Without casemix adjustment, programs with more severely ill patients can incorrectly appear to have worse outcomes than programs with less severely ill patients. Casemix adjustment helps to control for patient severity in order to compare programs or facilities more fairly.

Similar findings have also been reported for outpatient mental health treatment. Hendryx et al. (1999) developed a risk adjustment model to examine functional status and patient satisfaction outcomes among outpatients in community mental health clinics. The results showed that the agencies' relative rankings differed for casemix adjusted outcomes compared to unadjusted outcomes (see also Berlowitz et al., 1998; Khuri et al., 1998).

Prior studies of risk adjustment have included four main sets of indices: sociodemographic factors, diagnoses, prior service use, and symptoms and functioning at baseline. These sets of indices include many of the baseline patient characteristics that predict substance abuse treatment outcomes (e.g. Akerlind, Hornquist, & Bjurulf, 1988; Booth et al., 1991; Brewer et al., 1998; Carroll et al., 1993; McLellan et al., 1993; Ornstein & Cherepon, 1965; Pettinati et al., 1999; Rost et al., 1996; Strain et al., 1994; Woody et al., 1990). Sociodemographic characteristics typically include factors such as age, gender, marital status, and education. Diagnostic information consistently includes type of substance abuse diagnosis (Booth et al., 1991; Phibbs et al., 1997) and comorbid psychiatric diagnoses, especially the presence of AXIS I psychiatric diagnoses.

An important measure of prior service use is whether or not a patient was hospitalized for treatment of a substance use or psychiatric disorder in the prior year. Measures of symptoms and functioning at baseline typically assess patients' status at treatment entry on the outcome indices. We draw upon this prior work here to develop a casemix model consisting of a minimum best set of predictors that can be applied to VA patients in QSAM treatment evaluations.

Method

Patients

We evaluated casemix adjustment models using data drawn from two samples of VA patients with diagnosed substance use disorders. For convenience, we designate these samples as (1) the GPRA sample and (2) the Multisite sample. The fact that these two samples differ in the types of patients, assessment procedures, follow-up intervals, and completion rates enables us to examine the breadth of applicability of a casemix model.

The GPRA Sample. As part of its participation in the Government Performance Results Act (GPRA), the VA developed a project to conduct a naturalistic evaluation of VA substance abuse treatment in each facility and network. The Office of Performance and Quality established a guideline that mandated administration of the Addiction Severity Index (ASI; to be described below) to patients with diagnosed substance use disorders who entered VA treatment between July and September, 1997. A later guideline mandated readministration of the ASI at a 6-12 month follow-up of all patients initially assessed at baseline.

Overall, 34,251 patients in 150 facilities were assessed with the ASI in clinician-based interviews between July and September 1997. Between October 1997 and September 1998, clinicians readministered the ASI to 14,317 of the 34,251 patients (42% of the patients still alive; 744 patients had died). We focus here on a subset of these followed patients: 6,037 patients who were initially assessed within 14 days of entry into their index episode.[1] On average, there was a 9-month interval between the baseline and follow-up assessment. More details about the baseline and initial follow-up sample are provided in Moos et al. (1998; 1999).

Patients in the GPRA sample were primarily male (97%), unmarried (80%), and younger than 55 years of age (86%). Approximately 56% of the patients were Caucasian, 37% were African-American, and the rest were from other racial minorities. In terms of substance use, almost 71% of the patients had both alcohol and drug abuse/dependence diagnoses during their index episode; about 11% had a drug diagnosis only and 17% had only an alcohol diagnosis.[2] A majority (57%) of the patients had a co-occurring Axis I disorder, with the most common being depression (37%) and PTSD (19%); 12% had an Axis II disorder. In addition, 86% of patients had at least one medical diagnosis associated with their index episode.

The Multisite Sample. As part of the VA's continuing effort to evaluate its substance abuse services, and under a mandate stemming from the President's national drug control policy, the Mental Health Strategic Healthcare Group in VA Headquarters established the Program Evaluation and Resource Center (PERC). PERC monitors VA substance abuse treatment programs and patients' patterns of care, and conducts comparative evaluations of alternative treatment paradigms (Humphreys et al., 1997; Moos et al., 1999; Ouimette, Finney & Moos, 1997). As part

of its mandate, PERC conducted two prospective longitudinal evaluations of VA substance abuse care. We focus here on the 5,394 VA substance abuse patients in these two studies who were assessed at treatment intake and at a 1-year follow-up.

One evaluation focused on the process and outcome of 12-step, cognitive-behavioral, and eclectic treatment, which are the three most prevalent substance abuse treatment approaches in both VA and non-VA settings. To compare these three treatment orientations, and to examine the associations between continuing care and outcome, PERC conducted a prospective study of patients who entered treatment in one of a representative sample of 15 VA substance abuse programs: five 12-step programs, five cognitive behavioral programs, and five eclectic programs that combined the 12-step and cognitive behavioral approaches. The overall evaluation included 3,018 patients (84% of those assessed at intake and not known to have died) who completed an Intake Information Form on entry into inpatient treatment and a Follow-up Information Form at a 1-year follow-up (Moos et al., 1999).

The second evaluation was a prospective study of the VA Contract Residential Facilities Program. This program enabled the VA to place patients in approved community residential facilities (CRFs), and was established to provide substance abuse care in the least restrictive and least expensive setting. Specifically, CRFs provide patients with a supervised alcohol- and drug-free environment, monitor patients' medication use, and aid patients in enhancing their independent living and social skills.

Although community residential care is one option for substance abuse patients who are not yet ready for independent life in the community, little is known about the types of programs that are most effective or about the patients who are most likely to benefit from this treatment. The evaluation was designed to address these questions. It focused on 2,376 patients (86% of those included at intake and not known to have died) who entered one of a representative sample of 88 CRF's and were assessed at intake and at 1-year follow-up. More detail about this study is in Moos et al. (1997) and Moos (1998).

The combined Multisite sample consists almost entirely of men: only 22 patients (<1%) were women. Most of the patients were less than 55 years of age (90%) and unmarried (86%). Almost half (49%) were Caucasian and more than 40% were African-American (43%). The majority of patients had both an alcohol and a drug diagnosis (55%); 32% had an alcohol diagnosis only and 14% had a drug diagnosis only. About one quarter of the patients had an Axis I psychiatric diagnosis during their index stay and almost 15% had an Axis II psychiatric diagnosis. Depression (12%) and anxiety disorders (including PTSD, 11%) were the most common Axis I disorders. In addition, 80% of the patients had at least one medical diagnosis associated with their index stay.

Measures

We first describe the key outcome criteria and then outline the initial set of variables considered for the casemix model.

Outcome Indices. A set of outcome indices was created to tap three domains: substance use, psychological symptoms, and social functioning. Because we were primarily interested in predicting clinically meaningful aspects of remission, our main focus is on dichotomized measures of outcomes. However, we also examine the generalizability of the casemix model to the prediction of continuous outcomes. The six outcome indices are:

- Abstinence from alcohol and drug use, as measured by no reported use of the following substances: alcohol, heroin, street methadone, other opiates or analgesics, barbiturates, sedatives, cocaine, amphetamines, cannabis, hallucinogens, inhalants.[3]

- No current problems due to substance use. In the GPRA sample, this index was measured by two ASI questions that asked how many days in the last 30 the patient had experienced problems related to alcohol use and drug use. A report of zero days to both the question for alcohol use and the question for drug use qualified as no current problems due to substance use. In the Multisite sample, a series of 15 questions asked about whether, during the past three months, the patient had experienced problems due to substance use in a variety of domains (e.g. health, psychiatric, legal, family/social). A "no" response to all problems qualified as no current problems due to substance use.

- Psychological symptoms. In the GPRA study, the presence of psychological symptoms was indicated by a positive response on the ASI to experiencing any of the following during the past 30 days: serious depression, serious anxiety/tension, serious thoughts of suicide, suicide attempts, hallucinations, and trouble controlling violent behavior. In the Multisite sample, 12 items drawn from the depression and anxiety subscales of the Brief Symptom Inventory (BSI; Derogatis, 1993) were used. Responses of "quite a bit" or "extremely" to five or more of the BSI items on these two subscales qualified as the presence of psychological symptoms.

- Family/social conflict (yes/no), as measured by whether or not the patient reported on the ASI having experienced significant periods in the past 30 days during which there were serious problems getting along with any of the following people: mother, father, siblings, sexual partner/spouse, children, other significant family, close friends, neighbors, or coworkers. This measure was available only in the GPRA sample.

- Recent Arrest. In the GPRA sample, this measure was based on the whether the patient was currently awaiting trial or had been detained in the past 30 days. A yes response to either question qualified as recent arrest. In the Multisite sample, this measure was based on a single question that assessed whether or not the patient had been arrested in the last year.

- Employed status. In both samples, employed status was assessed via a single question and coded as yes/no.

Casemix Model. In developing the casemix model, we considered potential prognostic factors from four domains: sociodemographic characteristics, use of services in the prior year, diagnoses in the index episode, and the baseline value of each outcome. We examined four sociodemographic variables: gender (coded as male/female), race (coded as black/nonblack), married status (yes/no), and age (dichotomous variable coded as less than 55, age 55 and older). For the GPRA sample, demographic information was taken from the ASI interview; however, the data are also available in the VA health service utilization databases.

We examined VA health care use in the prior year as an indicator of treatment history. Treatment history was indexed by the number of episodes of inpatient or extended care indicated in the VA databases in the year prior to the index episode in which the patient had a substance abuse or psychiatric diagnosis. We coded this variable into three categories: none, one or two, and three or more episodes.

In terms of diagnostic information, we examined several diagnoses associated with the index episode: drug abuse/dependence, schizophrenic disorders, paranoid psychoses (bipolar/manic and affective psychosis), depression, PTSD and other anxiety disorders, personality disorders, and medical (non-mental health) diagnoses. On the basis of initial empirical analyses, we classified diagnoses into the following: (1) drug abuse/dependence; (2) Axis I psychiatric disorders (including schizophrenic/paranoid disorders, bipolar/manic affective psychoses, anxiety disorders including PTSD, and depressive disorders), (3) Axis II personality disorders, and (4) medical (non-mental health) diagnoses. Each diagnosis was coded as present or absent.

A set of dichotomous variables was created from the baseline data to parallel the outcome indices. These measures reflect patients' baseline status for each of the outcomes.

Analysis Plan

We used logistic regression analyses to identify a best minimum set of predictors for inclusion in the casemix model. First, we conducted logistic regression analyses in which all the sociodemographic characteristics, prior treatment, and diagnostic information was used to predict each of the outcomes. Next, we expanded these analyses to include the baseline value of the outcome in order to assess the unique contribution of information obtained directly from patients to the predictive model.

We then used a purposeful stepwise approach to trim the predictors to a best minimum set, excluding indices from the model that were not significant predictors for any of the outcomes. We also excluded predictors that were significant for only one or two outcomes, when neither of the outcomes was a substance abuse outcome.[4] We assessed statistical significance using $p < .05$ for all models; however, we also examined borderline results (i.e. $.05 < p < .10$).

Finally, for the GPRA sample, we examined the effects of casemix adjustment by comparing patients' adjusted outcomes across VA healthcare facilities. For these analyses, we focused primarily on two outcomes (abstinence and no problems related to substance use) and on two types of casemix adjustment: one that included all the best set predictors except the baseline value of the outcome, and one that also included the baseline value. We selected 20 facilities for each outcome in order to simplify the comparison. We rank-ordered the 150 facilities based on patients' unadjusted outcome rates and determined the quintile cutpoints for the outcomes so that facilities fell into one of five categories that ranged from the lowest 20% to the highest 20%. We then selected the largest 4 facilities within each quintile.

After selecting the facilities, we calculated adjusted outcome rates based on information from patients in those facilities. We obtained the predicted probabilities of the outcome for each patient and then calculated the facility specific means of these predicted probabilities. We again rank-ordered the facilities into quintiles based on their adjusted means for each of the outcomes and examined differences in the quintile ratings produced by the two types of adjustment.

Results

We first present patients' overall substance use, psychological symptom, and social functioning status at baseline and follow-up in the two samples. Next we focus on results of the regression analyses and development of the casemix model. We then present information about the generalizability of the casemix model by examining the performance of the model in inpatient and outpatient samples, and when applied to longer-term outcomes and to continuous outcomes. Finally, we present information about the effects of casemix adjustment by comparing patient outcomes, adjusted with and without patients' reports of their baseline status, across 20 facilities.

Overall, patients in both samples tended to improve between baseline and follow-up (Table 1). At follow-up, higher percentages of patients were abstinent, free of substance use problems, and employed. Fewer patients reported psychological symptoms or having been arrested.

Table 1. Baseline and Outcome Status of Patients in the GPRA and Multisite Samples (Dichotomous Indices)

Outcome Index (% of Patients)	GPRA Sample		Multisite Sample	
	Baseline	Outcome	Baseline	Outcome
Abstinence	14.0	39.9	3.7	39.0
No Substance Use Problems	22.1	47.5	3.7	31.2
Psychological Symptoms	65.5	58.1	43.5	28.0
Family/Social Conflict	44.0	32.6	NA	NA
Arrested	17.4	10.7	35.7	23.5
Employed	40.5	38.3	20.3	38.8

NA=Not Available

There are a number of differences between the two samples. The Multisite sample was composed entirely of inpatients at baseline, whereas only 56% of the GPRA sample received inpatient treatment during their index episode. The Multisite follow-up was conducted primarily by mailed self-report inventories and the follow-up interval was longer than in the GPRA sample, which was conducted by clinician interviews. The percentage of completed follow-ups also was much higher in the Multisite (84%) than in the GPRA sample (42%). Finally, although the measures in the two samples were conceptually comparable, they are not identical and some of the variation in percentages is likely due to differences in the measures. In the present context, these differences enable us to examine the consistency of predictors of outcome across different samples, assessment methods, and follow-up procedures.

The Casemix Model

The final best set of predictors in the casemix models includes indices from each of the four domains considered. We retained three sociodemographic characteristics in the final model: age at baseline, married status, and gender. Due to the small number of women, we did not include gender in the analyses for the Multisite sample.

In terms of prior treatment and diagnoses in the index episode, episodes of inpatient substance abuse or psychiatric care in the prior year and both Axis I and Axis II diagnoses generally were significant predictors. Finally, the baseline value of the outcome contributed significantly in all cases and, in fact, was the strongest predictor of each outcome.

Odds ratios from the final regression models are presented in Table 2 for the GPRA sample and Table 3 for the Multisite sample. In general, the findings were similar for the two samples, although the individual odds ratios differed for some of the predictors across the two studies. We first summarize the main findings for the GPRA sample and then comment on substantive differences for the Multisite sample.

The Casemix Model for the GPRA Sample. As shown in Table 2, older patients tended to have better outcomes at follow-up. They were more likely to be abstinent and free of substance use problems, and less likely to have psychological symptoms, to have experienced family/social conflict, or to have been arrested. However, older patients were also less likely to be employed. Married patients were more likely than unmarried patients to be free of substance use problems, but also more likely to report family/social conflict. Women were more likely to report family/social conflict.

Table 2. Casemix Model for Dichotomous Outcomes in the GPRA Sample

Predictors	Outcomes					
	Abstinence	No SA Problems	Psychological Symptoms	Family Conflict	Arrest	Employment
Demographic						
Age 55+	1.58**	1.89**	.58**	.52**	.50**	.44**
Married	.99	1.26**	1.06	1.39**	1.00	.91
Female	1.18	1.03	1.31	1.79**	.83	.93
Prior Treatment[1]						
1 or 2	.64**	.59**	1.33**	1.16*	1.01	.65**
3 or more	.36**	.38**	2.11**	1.41**	1.32	.55**
Diagnoses						
Axis I	1.12*	1.14*	1.91**	1.10	.97	.81**
Axis II	1.02	.91	1.44**	1.29**	.94	.99
Baseline Value	3.96**	3.00**	2.82**	2.50**	3.53**	5.48**
Model Fit[2]						
χ^2	312.16	275.33	302.19	256.11	177.76	872.40
Pseudo R^2	.08	.09	.13	.07	.04	.18

Note. Entries for the predictors are odds ratios; *p < .05, **p < .01

[1]The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year

[2] The χ^2 statistic presented here reflects the reduction in the –2 LogLikelihood when the baseline value of the outcome is added to sociodemographic, prior treatment, and diagnostic information. In all cases, the p-value of the χ^2 test for improvement in model fit is < .001 (df=1).

Patients who had hospital-based mental health treatment in the year prior to the index episode were less likely to be abstinent, free of substance use problems, or employed. They were also more likely to have psychological symptoms and to experience family/social conflict. In addition, patients who had more prior inpatient episodes tended to experience poorer outcomes. For example, patients who had one or two inpatient mental health episodes in the prior year were only 64% as likely to be abstinent at follow-up as were patients who had no mental health episodes in the prior year. Patients who had three or more prior episodes were only 36% as likely to be abstinent as were patients with no mental health episodes in the prior year.

Patients with an Axis I diagnosis were slightly more likely to be abstinent and free of substance use problems than were patients who did not have an Axis I diagnosis. However, they were more likely to report psychological symptoms and less likely to be employed. Patients who had an Axis II diagnosis were more likely to have psychological symptoms and to report family/social conflict.

The baseline value was significantly related to the corresponding outcome for all six indices. Across all the outcome criteria, inclusion of the baseline value significantly improved the fit of the model. In addition, the odds ratios show that the strength of the relationship between the intake values and the outcomes was substantial. For example, compared to patients who had substance abuse problems at baseline, patients who did not have substance abuse problems at baseline were three times as likely to be free of substance abuse problems at follow-up.

We have included a pseudo R^2 statistic to illustrate the degree to which the casemix model explains the outcomes. This statistic suggests that the model roughly explains between 4% and 18% of the variance in the six outcomes. This statistic should be interpreted with caution and is not necessarily recommended for assessing model fit (Hosmer & Lemeshow, 1989).

The Casemix Model for the Multisite Sample. Overall, the findings in the Multisite sample parallel those in the GPRA sample and, similarly, the pseudo R^2 illustrates the degree to which the casemix model explains the treatment outcomes (Table 3). In terms of the casemix findings, a few relationships were significant in the GPRA sample but not in the Multisite sample (e.g., the relationship between having an Axis I psychiatric diagnosis and abstinence).

Table 3. Casemix Model for Dichotomous Outcomes in the Multisite Sample

	Outcomes				
	Abstinence	No SA Problems	Psychological Symptoms	Arrest	Employment
Demographic					
Age 55+	1.40**	1.40**	.63**	.34**	.31**
Married	1.08	.97	.95	.93	1.30**
Prior Treatment[1]					
1 or 2	.84*	.84*	1.18*	1.14	.74**
3 or more	.66**	.77*	1.70**	1.28	.54**
Diagnoses					
Axis I	1.06	.89	2.25**	.96	.56**
Axis II	.84*	.76**	1.34**	1.13	.71**
Baseline Value	1.80**	2.42**	3.52**	2.63**	2.85**
Model Fit[2]					
χ^2	14.26	30.73	342.09	202.45	206.33
Pseudo R^2	.01	.01	.13	.05	.10

Note. Entries for the predictors are odds ratios; *$p < .05$, **$p < .01$

[1] The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year

[2] The χ^2 statistic presented here reflects the reduction in the −2 LogLikelihood when the baseline value of the outcome is added to sociodemographic, prior treatment, and diagnostic information. In all cases, the p-value of the χ^2 test for improvement in model fit is < .001 (df=1).

Conversely, some associations were significant in the Multisite sample but not in the GPRA sample (e.g. the relationship between having an Axis II diagnosis and substance use problems). In addition, the odds ratios for the relationships between the baseline values and the outcomes tend to be stronger in the GPRA sample than in the Multisite sample. This finding probably reflects the low base rate of abstinence and freedom from substance use problems and the longer follow-up interval in the Multisite sample. Overall, however, the basic model applies well to both samples.

Generalizability of the Casemix Model

We conducted additional analyses to examine the extent to which the casemix model can be generalized to patient samples and assessment methods that might be included in future QSAM projects. Most prior work on casemix indices, especially on VA samples, has been conducted on inpatients. To examine the generalizability of the casemix model, we compared the findings for patients who received inpatient treatment with those for patients who received only outpatient treatment. In addition, we present results from analyses that applied the casemix model to longer-term outcomes and to continuous outcome indices.

Inpatients and Outpatients. The GPRA sample afforded the opportunity to examine whether the basic casemix model held for outpatients as well as for inpatients. About 44% of patients in the GPRA sample received only outpatient treatment during their index episode, whereas the remaining 56% received inpatient treatment.

We compared the results of the final casemix model for inpatients and outpatients (Tables A1 and A2 in Appendix). Overall, the findings were similar in the two groups of patients, although a few relationships were significant for one group and not the other. For example, among inpatients, but not outpatients, having an Axis I disorder was significantly and positively related to abstinence.

Significant relationships between the predictors and the outcomes tended to be stronger for outpatients than for inpatients, especially the relationships between the baseline value and the corresponding outcome. For example, among outpatients, the odds of being free of substance abuse problems at outcome were 3.38 times greater for those who had no such problems compared to those who did have such problems at baseline. Among inpatients, the same odds ratio was 2.07. However, the basic finding that the baseline value was a strong and significant predictor of outcome across all six domains held for both inpatients and outpatients.

GPRA Patients' Longer-Term Follow-ups. As part of the longer-term GPRA outcomes monitoring process, all patients were sent a self-administered follow-up questionnaire that included the scored items from the ASI. A total of 12,515 patients completed and returned the follow-up survey; 5,773 of these patients had been given the baseline ASI interview at entry into their index episode of treatment. These 5,773 patients served as the sample we used to examine the applicability of the casemix model to longer-term outcomes. The outcome indices were constructed by the same

method used to create the interview-based outcomes. On average, there was an 18-month interval between the baseline and follow-up assessment.

The overall findings, shown in Table A3, were comparable to those based on the more temporally proximal, interview-based clinician follow-up (Table 2). All statistically significant relationships in the clinician interview analyses were either significant or in the same direction in the longer-term follow-up. However, several indices that were significant in the interview analyses were not as consistently predictive in the longer term follow-up. For example, in the shorter term follow-up, prior treatment was significantly associated with less positive outcomes for all outcomes, except arrest. In the longer-term follow-up, three or more prior treatment episodes significantly predicted substance abuse problems, psychological symptoms, family conflict, and employment, but was not related to abstinence. However, a significant relationship emerged between prior treatment and arrest. Notwithstanding these variations, the direction of the relationship remained the same in all cases.

As we found earlier in the short-term follow-up, the baseline value was a significant predictor across all six of the outcomes. The odds ratios were lower for the prediction of the longer term outcomes, however. These findings are consistent with expectations based on the longer time period between the baseline and follow-up, and methodological differences between interview and self-report data collection methods.

Continuous Outcomes. In the GPRA sample, we examined the generalizability of the casemix model to continuous outcome indices by applying it to ASI composite scores, which range from zero to one and are commonly reported in the substance abuse treatment evaluation literature. We examined the casemix model using multiple regression analyses and the ASI alcohol, drug, psychiatric, family/social, legal, and employment composite scores as the outcome criteria. The results, shown as standardized betas in Table 4, were comparable to those for the dichotomous outcomes (Table 2).

Older patients had better outcomes on each index except employment. Prior treatment was associated with poorer outcomes on all of the criteria, except legal problems. Axis I diagnoses were related to fewer alcohol and drug problems and, as expected, both Axis I and II diagnoses were related to more psychiatric problems. The intake value was positively associated with each of the six outcome criteria.

Table 4. Casemix Model for Continuous Outcomes in the GPRA Sample

Predictors	ASI Composite Score Outcomes					
	Alcohol Problems	Drug Problems	Psychiatric Problems	Family/ Social Problems	Legal Problems	Employment Problems
Demographic						
Age 55+	-.07**	-.07**	-.08**	-.07**	-.06**	.02*
Married	-.03*	-.01	.01	.03**	-.01	-.04**
Female	-.02	.01	.01	.03**	.02	-.02*
Prior Treatment[1]						
1 or 2	.09**	.06**	.06**	.05**	.01	.07**
3 or more	.13**	.04**	.09**	.05**	.00	.05**
Diagnoses						
Axis I	-.04**	-.05**	.12**	.02	-.00	.00
Axis II	.01	.01	.04**	.02	-.00	.00
Baseline Value	.42**	.57**	.43**	.34**	.28**	.59**
Model R^2	.21	.36	.31	.14	.09	.38

Note. Entries for the predictors are standardized beta coefficients; $*p < .05$, $**p < .01$

[1]The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year.

The overall fit of the model, as measured by R^2, was much greater when the intake value was included. For example, the casemix model explained 21% of the variance in alcohol problems when the intake value was included, whereas without the intake value the model explained only 4% of the variance. Similarly, the model explained 36% of the variance in the drug problems score when the intake value was included, compared with only 6% when the intake value was not included.

To further examine the generalizability of the casemix model, we conducted multiple linear regression analyses with the continuous outcome criteria in the multisite sample. The outcomes included alcohol consumption (measured as the total ounces of ethanol consumed on a heavy drinking day), a 15-item measure of problems related to substance use, and a measure of psychological distress (combining items from the anxiety and depression subscales of the BSI).

The primary results (shown in Table 5) were consistent with those reported for the dichotomous outcomes (Table 3). Older patients experienced better outcomes, whereas prior treatment was associated with poorer outcomes. Axis I and Axis II diagnoses were associated with more psychological distress, but not with alcohol consumption. For each of the three continuous outcome measures, the baseline value was positively associated with the outcome.

Table 5. Casemix Model for Continuous Outcomes in the Multisite Sample

Predictors	Outcomes		
	Alcohol Consumption[1]	Drinking Problems	Psychological Distress
Demographic			
Age 55+	-.03*	-.07**	-.04**
Married	-.03*	.01	-.01
Prior Treatment[2]			
1 or 2	.03*	.03*	.04**
3 or more	.06**	.04**	.06**
Diagnoses			
Axis I	.02	.02	.14**
Axis II	-.00	.04**	.05**
Baseline Value	.33**	.31**	.41**
Model R^2	.12	.12	.26

Note. Entries for the predictors are standardized beta coefficients; *p < .05, **p < .01

[1]Total ounces of ethanol consumed on a heavy drinking day.

[2]The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year.

Adjusted Outcomes With and Without Patients' Status at Baseline

In this section we present results comparing two sets of adjusted percentages across facilities for two outcomes among the GPRA patients: abstinence and freedom from substance use problems. One adjustment was made using only the best set of predictors available from the VA databases. The second adjustment included the baseline value of the outcome criterion in addition to the information available from the VA databases. These findings enable us to examine the effects of casemix adjustment with and without information obtained directly from patients.

Adjusted facility-specific means for the outcomes and their respective quintile rankings are presented in Tables 6 and 7. Overall, inclusion of patients' reports about their status at baseline affects facilities' relative rankings. We examined the extent to which rankings differed between the two types of adjustment and compared the composition of the extremes, the first and fifth quintiles (i.e., the top and bottom 20%), to illustrate how the inclusion of patients' reports about their baseline status affected the facilities' relative rankings.

Facility Variation in Patients' Abstinence Rates. With respect to abstinence, substantial changes were noted in facilities that comprised the top 20%. Shreveport, St. Cloud, Tuscaloosa, and West Haven were categorized in the top quintile when the casemix model was based only on database information (Table 6). However, none remained in the top quintile when patients' baseline reports were added to the model: Shreveport, St. Cloud, and West Haven moved to the second quintile and Tuscaloosa moved to the fourth quintile. Buffalo, Cincinnati, Lexington, and Seattle moved up to comprise the top quintile. Prior to adding patients' baseline information to the casemix model these facilities had been in the second (Buffalo and Seattle), fourth (Lexington) and fifth (Seattle) quintiles.

Less change was observed in the bottom 20%. Battle Creek, Cincinnati, Roseberg, and St. Louis were in the bottom quintile in the model that used only database information. All except Cincinnati (which moved to the top quintile) remained in the bottom quintile when patients' baseline reports were added to the model.

There were some other notable differences in facilities' rankings based on the two models. For example, Lexington ascended from the 4th quintile to the 1st, and Jackson from the 4th quintile to the second. Conversely, Little Rock, Memphis, and Oklahoma all declined from the 2nd quintile to the 4th. Overall, the differences between the two types of adjustment changed the quintile rankings for approximately 75% of the facilities. In 40%, the change was a single quintile; approximately 25% changed two quintiles, two (10%) changed three quintiles, and one facility changed four quintiles.

Table 6. Abstinence: Comparison of Facility Means for Casemix Models Based on VA Database Information Versus VA Database Information and Patients' Reports of Baseline Status

Facility	Database Information Only		Patients' Reports Included	
	%	Quintile	%	Quintile
Baltimore	38.8	3	38.9	3
Battle Creek	37.3	5	35.2	5
Brooklyn	38.8	3	39.2	3
Buffalo	39.1	2	42.5	1
Cincinnati	36.4	5	42.4	1
Cleveland	39.1	2	38.8	3
Jackson	38.6	4	41.5	2
Lexington	38.0	4	41.6	1
Little Rock	39.1	2	38.6	4
Memphis	39.2	2	36.3	4
New York City	38.9	3	39.9	2
Oklahoma City	39.4	2	36.0	4
Philadelphia	38.0	4	35.5	5
Roseburg	36.1	5	33.8	5
Seattle	39.7	2	47.9	1
Shreveport	40.1	1	41.3	2
St. Louis	36.7	5	34.3	5
St. Cloud	41.0	1	40.2	2
Tuscaloosa	39.9	1	38.6	4
West Haven	40.3	1	39.9	2
Range	36.1 to 41.0		33.8 to 47.9	
Mean (S.D.)	38.7 (1.3)		39.1 (3.4)	

Facility Variations in Patients' Rates of Being Free of Substance Use Problems. For the outcome of freedom from current substance use problems, about 40% of facilities had the same rating with both types of adjustment, whereas 35% differed by one quintile, 20% differed by two quintiles, and 5% differed by three quintiles (Table 7).

Two facilities (Manchester and Marion, Illinois) remained in the first quintile when patients' baseline reports were added to the database information. The other two facilities (Omaha and St. Cloud) dropped from the first quintile to the second quintile. Conversely, when patients' baseline reports were used, Seattle rose from the second to the first quintile and New York rose from the fourth to the first quintile. Bedford, Cincinnati, Cleveland, and St. Louis were all in the bottom quintile when adjustment did not include the baseline value. When baseline information was added, Philadelphia and Coatesville both declined from the third to the fifth quintiles while Cincinnati rose to the third quintile and Cleveland to the fourth quintile.

Table 7. Freedom from Problems Due to Substance Use: Comparison of Facility
Means for Casemix Models Based on VA Database Information Versus
VA Database Information and Patients' Reports of Baseline Status

Facility	Database Information Only		Patients' Reports Included	
	%	Quintile	%	Quintile
Baltimore	46.3	4	45.0	4
Bedford	43.1	5	39.9	5
Buffalo	48.2	3	50.5	2
Cincinnati	44.9	5	47.1	3
Cleveland	45.9	5	45.6	4
Coatesville	47.0	3	43.7	5
Jackson	46.9	4	46.3	3
Little Rock	46.5	4	45.2	4
Manchester	55.7	1	58.6	1
Marion, Illinois	53.1	1	61.6	1
New Orleans	48.2	3	48.6	3
New York City	46.4	4	52.8	1
Oklahoma City	48.6	2	45.2	4
Omaha	49.0	1	51.2	2
Philadelphia	47.0	3	43.6	5
Seattle	48.7	2	55.0	1
St. Louis	44.1	5	41.8	5
St. Cloud	50.0	1	49.6	2
Tuscaloosa	48.8	2	50.1	2
West Haven	48.8	2	47.4	3
Range	43.1 to 55.7		39.9 to 61.6	
Mean (S.D.)	47.9 (2.9)		48.4 (5.4)	

Comment

Risk adjustment is important in program evaluations and outcomes monitoring. Failure to account for patient baseline characteristics that are related to outcomes can lead to incorrect conclusions about the relative performance of specific treatment programs or approaches. Accordingly, to facilitate the comparison of substance abuse treatments in QSAM projects, we developed a relatively simple, generalizable casemix model.

We tested the casemix model in two independent samples of VA patients and found the results to be similar despite the different study methodologies, timeframes, and patient populations. We also examined the performance of the casemix model when applied to inpatients versus outpatients, longer-term follow-ups, and continuous as well as dichotomous outcomes. Finally, we compared results of casemix adjustment with and without patients' baseline information to examine differences in the resulting facility level rankings.

Conclusions

The casemix model includes sociodemographic characteristics (age, married status, gender), diagnostic information (co-occurring Axis I and Axis II psychiatric disorders), information about prior treatment for substance abuse, and information obtained directly from patients about their status at baseline. Taken together, these factors accounted for between 1% and 18% of the variance in the dichotomous outcomes and between 9% and 38% of the variance in the continuous outcomes.

In general, other patient characteristics we examined did not significantly predict the outcomes and therefore were not included in the final model. These characteristics include: race, specific psychiatric diagnoses, medical diagnosis, and drug diagnosis. Although gender was only significantly related to family/social conflict, we retained it in the final model due to the increasing number of women in the military and the potential for differences to be noted later on.

Overall, our findings demonstrate the importance of including information obtained directly from patients at baseline in an adequate casemix model. For all outcomes and in both patient samples, the baseline value significantly improved the casemix model, and, in fact, was usually the single strongest predictor.

In addition to being a strong and significant predictor of outcomes, baseline status also affected the results of facility-level comparisons: risk-adjusted findings differed depending on whether or not the baseline value was included. For example, when we examined patients' rates of abstinence across 20 facilities, none of the facilities that were in the top quintile when casemix adjustment did not include baseline status remained in the top quintile when baseline status was added. These findings confirm the need to include baseline information about patients' substance use, symptoms, and functioning in risk adjustment procedures.

We developed and tested the casemix model based on information obtained from two different sets of assessment procedures in two independent samples of patients. The overall consistency of the findings in the GPRA and the Multisite samples support the generalizability of the model. In addition, the casemix model appears to be generalizable to outpatients, to longer-term follow-ups, and to continuous as well as dichotomous outcomes.

It should be noted that "perfect" casemix adjustment, that is, control of all patient variables that are related to outcome and to treatment status, is an impossible ideal to achieve. Additional research is needed to identify a "silver standard" of "acceptable" casemix adjustment. Presumably, the imperfections of any casemix model become more important as the performance of more disparate programs (in terms of patient characteristics) is compared. Better conceptualizations of and research on "adequate casemix adjustment" are needed.

Recommendations

We recommend that the model presented in this report be used in QSAM evaluations. This standard casemix model can serve as a basis for the development of more detailed models for specific projects where needed. We also recommend that a casemix index include indices based on patients' reports of their baseline status, as well as information from the VA utilization databases.

Acknowledgements

Footnotes

[1]Thirty-nine patients were not included due to missing information for one or more of the casemix predictor variables.

[2]About 1% of the sample did not have a substance abuse diagnosis recorded for their index episode.

[3]In the GPRA sample, abstinence from alcohol use required both no use of alcohol and no use of alcohol to intoxication. In addition, the ASI does not specify street versus therapeutic methadone use. Therefore, in the GPRA sample, we only included methadone use if it was reported in addition to at least one other substance. When methadone was the only substance used, we considered that its use was likely to be part of treatment. Information about outpatient services obtained from the VA National Patient Care Database showed that 98% of the followed patients who reported only methadone use actually were receiving methadone maintenance treatment (Moos et al., 1999).

[4]Gender was included in the casemix model for the GPRA sample even though it was only a significant predictor of family/social conflict. We retained gender because of its potential future significance as more women are seen in the VA.

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Appendix A

Tables for Subsidiary Casemix Model Analyses

Table A1. Casemix Model for Dichotomous Outcomes in GPRA Inpatients

Predictors	Outcomes					
	Abstinence	No SA Problems	Psychological Symptoms	Family Conflict	Arrest	Employment
Demographic						
Age 55+	1.50**	1.79**	.64**	.53**	.48**	.43**
Married	.89	1.07	1.03	1.63**	1.02	.93
Female	1.11	.98	1.88*	1.72*	.97	1.11
Prior						
Treatment[1]	.69**	.67**	1.28**	1.10	1.03	.70**
1 or 2	.40**	.46**	1.92**	1.29*	1.17	.52**
3 or more						
Diagnoses						
Axis I	1.20*	1.18*	1.99**	1.18	.99	.88
Axis II	.94	.96	1.35**	1.24*	.86	1.01
Baseline Value	2.65**	2.07**	2.27**	2.38**	3.45**	4.54**
Model Fit[2]						
χ^2	49.63	49.98	97.09	131.93	96.05	381.88
Pseudo R^2	.01	.04	.10	.07	.03	.15

Note. Entries for the predictors are odds ratios; *p < .05, **p < .01

[1]The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year

[2] The χ^2 statistic presented here reflects the reduction in the −2 LogLikelihood when the baseline value of the outcome is added to sociodemographic, prior treatment, and diagnostic information. In all cases, the p-value of the χ^2 test for improvement in model fit is <.001 (df=1).

Table A2. Casemix Model for Dichotomous Outcomes in GPRA Outpatients

Predictors	Outcomes					
	Abstinence	No SA Problems	Psychological Symptoms	Family Conflict	Arrest	Employment
Demographic						
Age 55+	1.64**	2.13**	.50**	.52**	.53**	.44**
Married	1.11	1.43**	1.12	1.19	1.00	.89
Female	1.25	1.02	1.03	1.85**	.71	.75
Prior						
Treatment[1]	.53**	.52**	1.32**	1.23	.89	.57**
1 or 2	.24**	.29**	2.39**	1.92**	1.77	.74
3 or more						
Diagnoses						
Axis I	1.02	1.24*	1.76**	1.01	.89	.75**
Axis II	1.31	1.10	1.66*	1.61*	1.09	.97
Baseline Value	5.14**	3.38**	3.52**	2.68**	3.72**	6.96**
Model Fit[2]						
χ^2	270.48	179.83	212.56	126.16	83.62	500.45
Pseudo R^2	.13	.12	.15	.07	.04	.22

Note. Entries for the predictors are odds ratios; *p < .05, **p < .01

[1]The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year

[2] The χ^2 statistic presented here reflects the reduction in the −2 LogLikelihood when the baseline value of the outcome is added to sociodemographic, prior treatment, and diagnostic information. In all cases, the p-value of the χ^2 test for improvement in model fit is <.001 (df=1).

Table A3. Casemix Model for Longer-Term Dichotomous Outcomes in the
GPRA Sample

Predictors	Outcomes					
	Abstinence	No SA Problems	Psychological Symptoms	Family Conflict	Arrest	Employment
Demographic						
Age 55+	1.13	1.32**	.47**	.37**	.32**	.39**
Married	1.06	1.12	1.19*	1.26**	1.03	.78**
Female	1.05	1.09	1.16	1.29	.70	1.20
Prior Treatment[1]						
1 or 2	1.07	.87	1.41**	1.26**	1.18	.75**
3 or more	.93	.76*	1.66**	1.18	1.50*	.53**
Diagnoses						
Axis I	1.28**	1.00	2.23**	1.52**	.84	.67**
Axis II	1.12	1.07	1.01	1.20	1.22	1.04
Baseline Value	2.51**	2.28**	2.93**	1.79**	2.52**	5.10**
Model Fit[2]						
χ^2	149.75	136.12	280.33	107.09	79.24	668.78
Pseudo R^2	.03	.04	.14	.08	.03	.18

Note. Entries for the predictors are odds ratios; *p < .05, **p < .01

[1]The comparison group is patients who had no inpatient episodes of mental health treatment in the prior year

[2] The χ^2 statistic presented here reflects the reduction in the −2 LogLikelihood when the baseline value of the outcome is added to sociodemographic, prior treatment, and diagnostic information. In all cases, the p-value of the χ^2 test for improvement in model fit is <.001 (df=1).